

Detection of magnetic nanoparticles in deep position by using pulsed magnetic field

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Breast cancer is known to have metastasis via lymph vessels and lymph nodes. Sentinel lymph node (SLN) biopsy is effective to determine whether breast cancer has metastasized or not. SLN is the lymph which cancer cells first reaches. In order to perform the biopsy, it is necessary to identify the location of SLN. Conventionally, a method using radioisotope and blue dye has been mainstream, however in recent years, a method using magnetic field has attracted attention. After magnetic nanoparticles are injected near the breast cancer, they flow into SLN using the lymph flow. The position of SLN is identified by detecting magnetic nanoparticles from outside the body. Previous studies have reported using permanent magnets [1] and AC magnetic field but the accuracy is not enough for patients with high BMI. Because a pulsed magnetic field generates larger magnetic fields compared to them, highly accurate tests are expected for patients with high BMI. Resovist® (Fuji Film Co.) including superparamagnetic particles was used in this study. Two search coils used as sensors to detect magnetic nanoparticles were connected with opposite polarities. The voltage ratio of EMFs generated from the two coils was changed by a potentiometer, and thereby EMFs of them were canceled. Fig. 1 shows canceled EMFs of two 50-turn search coils in the case of a blank that there is nothing inside two coils and in the case where Resovist® was inserted into each coil. Generated pulsed magnetic field reaches a peak at 2 ms. Measured EMFs were integrated by Eq. (1) as shown in Fig. 2 and the signal amplitude ΔB^* of Resovist® at 2 ms was evaluated.

$$B^* = \int V dt. \quad (1)$$

From now on, we try to detect Resovist® in deep position.

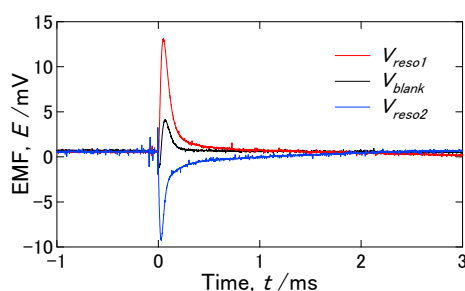


Fig. 1 Detected EMFs

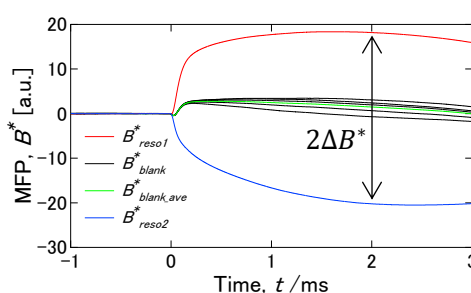


Fig. 2 Detected MFPs by integrating EMFs

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References: [1] Masaki Sekino *et al.*, Scientific Reports **8** (2018) 1195.

[2] Ryota Motoki *et al.*, JSAP Autumn meeting 19a-E201-2, Abs. DVD 09-115 (2019).